CLAIMS:

1. A method of suppressing side lobe interference in a beamforming process, the method comprising:

receiving a plurality of sensor signals comprising elemental data;

forming a main beam comprised of main beam samples using all of the sensor signals;

combining a subset of the sensor signals into signal pairs;

calculating a complex weighting factor for each signal in a pair such that the maximum response axis of the resulting signal pair combination is aligned with the maximum response axis of the main beam;

assigning opposite amplitudes to each signal in the pair to produce delta-channel auxiliary signals having zero response along the maximum response axis;

computing a covariance matrix, M, using the delta-channel auxiliary signals;

computing a cross-covariance vector, Λ, using the delta-channel auxiliary signals and the main beam;

computing a vector of delta-channel auxiliary signal weights;

multiplying each sample from each delta-channel auxiliary signal by its corresponding weight to yield weighted delta-channel auxiliary signals;

summing the weighted delta-channel auxiliary signals to obtain suppressor channel samples; and

subtracting the suppressor channel samples from the main beam samples to obtain an interference-free main beam.

2. The method of claim 1 wherein the signal pairs are comprised of signals from sensors that are adjacently located near the edges of the array.

3. The method of claim 1 wherein each member of the covariance matrix, M, is an estimate of the covariance between two delta-channel auxiliary signals such that the whole matrix contains estimates of every possible delta-channel auxiliary signal combination and the main diagonal of the covariance matrix contains the variance of the corresponding delta-channel auxiliary signal.

4. The method of claim 3 wherein the covariance matrix, M, is calculated according to:

$$M = \frac{1}{N}\left(A \cdot A^H\right).$$

where,

the delta-channel auxiliary signal samples are arranged along columns in a matrix A;

N is the number of samples; and

H denotes combined conjugation and transposition.

5. The method of claim 4 wherein the samples from the main beam are arranged in a column vector, $\boldsymbol{B_0}$, and the cross-covariance vector, Λ, is calculated according to:

$$\Lambda = \frac{1}{N}\left(A \cdot B_0^H\right).$$

6. The method of claim 5 wherein the delta-channel auxiliary signal weights are calculated according to:

$$w = \left(M^{-1}\Lambda\right)^{*}$$

where the (*) symbol denotes conjugation.

7. The method of claim 1 further comprising:

applying an element-by-element weighting to the elemental data to adjust the maximum response axis of the array of sensors and to reduce array sidelobe levels.

8. A system for suppressing side lobe interference in a beamforming process, the system comprising:

means for receiving a plurality of sensor signals comprising elemental data;

means for forming a main beam comprised of main beam samples using all of the sensor signals;

means for combining a subset of the sensor signals into signal pairs;

means for calculating a complex weighting factor for each signal in a pair such that the maximum response axis of the resulting signal pair combination is aligned with the maximum response axis of the main beam;

means for assigning opposite amplitudes to each signal in the pair to produce delta-channel auxiliary signals having zero response along the maximum response axis;

means for computing a covariance matrix, M, using the delta-channel auxiliary signals;

means for computing a cross-covariance vector, Λ, using the delta-channel auxiliary signals and the main beam;

means for computing a vector of delta-channel auxiliary signal weights;

means for multiplying each sample from each delta-channel auxiliary signal by its corresponding weight to yield weighted delta-channel auxiliary signals;

means for summing the weighted delta-channel auxiliary signals to obtain suppressor channel samples; and

means for subtracting the suppressor channel samples from the main beam samples to obtain an interference-free main beam.

9. The system of claim 8 wherein the signal pairs are comprised of signals from sensors that are adjacently located near the edges of the array.

10. The system of claim 8 wherein each member of the covariance matrix, M, is an estimate of the covariance between two delta-channel auxiliary signals such that the whole matrix contains estimates of every possible delta-channel auxiliary signal combination and the main diagonal of the covariance matrix contains the variance of the corresponding delta-channel auxiliary signal.

11. The system of claim 10 wherein the covariance matrix, M, is calculated according to:

$$M = \frac{1}{N}\left(A \cdot A^{H}\right).$$

where,

the delta-channel auxiliary signal samples are arranged along columns in a matrix A;

N is the number of samples; and

H denotes combined conjugation and transposition.

12. The system of claim 11 wherein the samples from the main beam are arranged in a column vector, $\boldsymbol{B_0}$, and the cross-covariance vector, Λ, is calculated according to:

$$\Lambda = \frac{1}{N}\left(A \cdot B_0^{H}\right).$$

13. The system of claim 12 wherein the delta-channel auxiliary signal weights are calculated according to:

$$w = \left(M^{-1}\Lambda\right)^{*}$$

where the (*) symbol denotes conjugation.

14. The system of claim 8 further comprising:

means for applying an element-by-element weighting to the elemental data to adjust the maximum response axis of the array of sensors and to reduce array sidelobe levels.

15. A system for suppressing side lobe interference in a beamforming process comprising:

a processor readable storage medium;

code recorded in the processor readable storage medium to receive a plurality of sensor signals comprising elemental data;

code recorded in the processor readable storage medium to form a main beam comprised of main beam samples using all of the sensor signals;

code recorded in the processor readable storage medium to combine a subset of the sensor signals into signal pairs;

code recorded in the processor readable storage medium to calculate a complex weighting factor for each signal in a pair such that the maximum response axis of the resulting signal pair combination is aligned with the maximum response axis of the main beam;

code recorded in the processor readable storage medium to assign opposite amplitudes to each signal in the pair to produce delta-channel auxiliary signals having zero response along the maximum response axis;

code recorded in the processor readable storage medium to compute a covariance matrix, M, using the delta-channel auxiliary signals;

code recorded in the processor readable storage medium to compute a cross-

covariance vector, Λ, using the delta-channel auxiliary signals and the main beam;

code recorded in the processor readable storage medium to compute a vector of delta-channel auxiliary signal weights;

code recorded in the processor readable storage medium to multiply each sample from each delta-channel auxiliary signal by its corresponding weight to yield weighted delta-channel auxiliary signals;

code recorded in the processor readable storage medium to sum the weighted delta-channel auxiliary signals to obtain suppressor channel samples; and

code recorded in the processor readable storage medium to subtract the suppressor channel samples from the main beam samples to obtain an interference-free main beam.

16. The system of claim 15 wherein the signal pairs are comprised of signals from sensors that are adjacently located near the edges of the array.

17. The system of claim 15 wherein each member of the covariance matrix, *M*, is an estimate of the covariance between two delta-channel auxiliary signals such that the whole matrix contains estimates of every possible delta-channel auxiliary signal combination and the main diagonal of the covariance matrix contains the variance of the corresponding delta-channel auxiliary signal.

18. The system of claim 17 wherein the covariance matrix, M, is calculated according to:

$$M = \frac{1}{N}\left(A \cdot A^{H}\right).$$

where,

the delta-channel auxiliary signal samples are arranged along columns in a matrix A;

N is the number of samples; and

H denotes combined conjugation and transposition.

19. The system of claim 18 wherein the samples from the main beam are arranged in a column vector, $\boldsymbol{B_0}$, and the cross-covariance vector, Λ, is calculated according to:

$$\Lambda = \frac{1}{N}\left(A \cdot B_0^{H}\right).$$

20. The system of claim 19 wherein the delta-channel auxiliary signal weights are calculated according to:

$$w = \left(M^{-1}\Lambda\right)^{*}$$

where the (*) symbol denotes conjugation.

21. The system of claim 15 further comprising:

applying an element-by-element weighting to the elemental data to adjust the

18. The system of claim 17 wherein the covariance matrix, M, is calculated according to:

$$M = \frac{1}{N}\left(A \cdot A^{H}\right).$$

where,

the delta-channel auxiliary signal samples are arranged along columns in a matrix A;

N is the number of samples; and

H denotes combined conjugation and transposition.

19. The system of claim 18 wherein the samples from the main beam are arranged in a column vector, $\boldsymbol{B_0}$, and the cross-covariance vector, Λ, is calculated according to:

$$\Lambda = \frac{1}{N}\left(A \cdot B_0^{H}\right).$$

20. The system of claim 19 wherein the delta-channel auxiliary signal weights are calculated according to:

$$w = \left(M^{-1}\Lambda\right)^{*}$$

where the (*) symbol denotes conjugation.

21. The system of claim 15 further comprising:

applying an element-by-element weighting to the elemental data to adjust the maximum response axis of the array of sensors and to reduce array sidelobe levels.